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HOW DOES FLUORESCENT ORGANIC MATTER CHANGE IN OZONATED RECIRCULATING AQUACULTURE SYSTEMS?

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In intense recirculating aquaculture systems (RAS) organic and inorganic compounds are accumulated, eventually deteriorating the water quality. In a continuously-ozonated RAS, the water quality is improved, as organic matter is oxidized by ozonation and bacterial abundance is reduced. To detect and monitor dissolved organic matter (DOM) in aquatic systems, absorption spectroscopy of the coloured fraction (CDOM) has been used. A part of CDOM also fluoresces (FDOM). FDOM fraction has been widely used in aquatic environments as a quantitative and qualitative measure of DOM. FDOM can be characterised by the fluorescence excitation-emission matrix (EEM) spectroscopy which can be further decomposed mathematically (e.g. PARAFAC) to identify the independent FDOM fractions.

Recently, it was shown that the fluorescent organic matter of RAS water is highly sensitive to ozonation and fluorescence spectroscopy could therefore be used as an indirect method to determine ozone delivery within these systems. Therefore, three ozone dosages, including a control, were injected in pilot freshwater RAS where trout were farmed. The ozonation trial lasted eight days utilising one RAS per dosage. The test levels ranged from 52-130 mg O_3/h, corresponding to 10-25 g O_3/kg feed.

The DOM consisted of four components (Fig. 1) which differed in their fluorescence characteristics and response to ozone. A UV wavelength fluorescent fraction (C_{340}) typical of proteinaceous material removed by 13-20% immediately after ozone initiation. The remaining fractions that exhibited visible wavelength fluorescence, at first were unaffected but during the following days, were gradually degraded, reaching a removal of 34-66%. By the end of the experiment the fluorescence intensities of all fractions were diminished up to 60% in all applied dosages.

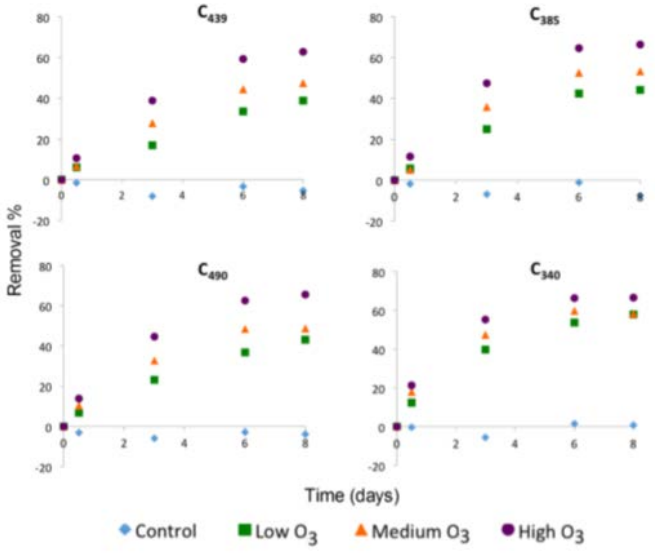

Figure 1: Effect of ozone on FDOM over time.

This study provides the first application of fluorescent EEM spectroscopy and PARAFAC analysis to determine the effect of ozone on FDOM character in aquaculture water, more specifically within continuously-treated RAS. The results indicate that the response in organic matter fluorescence can be used to depict the impact of ozone dosage.